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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/773,565	02/06/2004	Han Ming Wu	021653-002100US	3550

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EXAMINER

NGUYEN, THANH T

ART UNIT PAPER NUMBER

2813

DATE MAILED: 08/18/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 10/773,565	Applicant(s) WU ET AL.	
	Examiner Thanh T. Nguyen	Art Unit 2813	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-20 is/are pending in the application.
- 4a) Of the above claim(s) ____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed.
- 6) ☒ Claim(s) 1-4, 8-14 and 17-20 is/are rejected.
- 7) ☒ Claim(s) 5-7, 15 and 16 is/are objected to.
- 8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on ____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. ____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. ____. |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date ____. | 6) <input type="checkbox"/> Other: ____. |

DETAILED ACTION

Priority

Acknowledgment is made of applicant's claim for foreign priority based on an application filed in China on 12/30/03. It is noted, however, that applicant has not filed a certified copy of the 200310122966.4 application as required by 35 U.S.C. 119(b).

Receipt is acknowledged of papers filed under 35 U.S.C. 119 (a)-(d) based on an application filed in China on 12/30/03. Applicant has not complied with the requirements of 37 CFR 1.63(c), since the oath, declaration or application data sheet does not acknowledge the filing of any foreign application. A new oath, declaration or application data sheet is required in the body of which the present application should be identified by application number and filing date.

Specification

The title of the invention is not descriptive. A new title is required that is clearly indicative of the invention to which the claims are directed.

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

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Claims 1-20 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The limitation “the first peripheral region located higher than the first central region” in claims 1 and 11 render the claims indefinite because it is unclear how the convex surface has the peripheral region located higher than the first central region. It is suggested to change to “the first peripheral region located lower than the first central region” (see specification page 9, lines 17-18).

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 1, 9-11, 18-19, are rejected under 35 U.S.C. 102(e) as being anticipated by Hsieh et al. (U.S. Patent Publication No. 2004/0077175).

1- A method for making an opening for electrical contact, the method comprising:
performing a first etch through a first dielectric layer (102) to form a first via (200) and a second dielectric layer (101);

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filling the first via (200) with a BARC material (107) to form a first BARC layer;
performing a second etch on the first BARC layer to form a second BARC layer (see figure 5),
the second etch having a first etch rate in a first peripheral region of the second BARC layer and
a second etch rate in a first central region of the second BARC layer, the first peripheral region
located around a sidewall of the first via, the first central region located around a center of the
first via, the first etch rate being larger than the second etch rate, the first peripheral region
located higher than the first central region, a first top surface of the second BARC layer having
substantially a first convex shape (see figure 5, paragraphs# 35-39), noted that it is inherent that
the peripheral area etched deeper than the central region, therefore, the peripheral area has a
larger etch rate than the second etch rate of the central region.

performing a third etch through a second dielectric layer to form a trench and a third BARC
layer, the trench having a trench bottom surface, the trench bottom surface being substantially
free from any spike around a side surface of the third BARC layer, a second top surface of the
third BARC layer having substantially a second convex shape (see figure 5, paragraphs# 35, 37);
removing the third BARC layer to form a second via (see figure 6, and claim 15). Noted that this
rejection is based on the interpretation of 112 rejection above.

9- filling the trench and the second via with a conductive material (see claim 18)

10- the first dielectric layer comprises at least one selected from silicon oxide, FSG, and silicon
nitride(see paragraph# 26).

11. A method for making an electrical contact, the method comprising:

performing a first etch through a first protective layer (104) and a first dielectric layer (102) to
form a first via, a second protective layer and a second dielectric layer, the first protective layer

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located on the first dielectric layer (see figure 1a);

filling the first via with a BARC material (see figure 2) to form a first BARC layer (107);

performing a second etch on the first BARC layer to form a second BARC layer, the second etch having a first etch rate in a first peripheral region of the second BARC layer and a second etch rate in a first central region of the second BARC layer, the first peripheral region located around the sidewall of the first via, the first central region located around a center of the first via, the first etch rate being larger than the second etch rate, the first peripheral region located higher than the first central region (see figure 5, paragraphs# 35-39),), noted that it is inherent that the peripheral area etched deeper than the central region, therefore, the peripheral area has a larger etch rate than the second etch rate of the central region.

performing a third etch through a second protective layer and a second dielectric

layer to form a trench and a third BARC layer, the trench having a trench bottom surface, the trench bottom surface being substantially free from any spike around a side surface of the third BARC layer (see figure 5, paragraphs# 35, 37);

removing the third BARC layer to form a second via, a cross-section of the second via being smaller than a cross-section of the trench; (see figure 6, and claim 15). Noted that this rejection is based on the interpretation of 112 rejection above.

removing the third BARC layer to form a second via, performing a fourth etch through a stop layer (105) to form a third via, the dielectric layer located on the stop layer (see figure 6);

filling the trench and the third via with a conductive material (see claim 18).

18- wherein the first dielectric layer comprises at least one selected from silicon oxide, FSG, and silicon nitride (paragraphs# 26).

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19- wherein the conductive material comprises at least one selected from a group consisting of copper, aluminum, tungsten, and polysilicon (see claim 18).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claim 2-4, 8, 12-14, 17, 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hsieh et al. (U.S. Patent Publication No. 2004/0077175) as applied to claims 1, 9-11, 18-19 above in view of Kanegae et al. (U.S. Patent Publication No. 2004/0106297) and Gabriel et al. (U.S. Patent No. 6,472,231).

Hsieh et al. teaches forming a dual damascene structure by plasma etching at the pressure of 20-100mTorr. However, the reference does not teach the electron temperature of plasma process, the average magnitude of the plurality of angles being smaller than 5 degrees, the plasma density exceeding 5×10^{16} ions/m³, the second etch uses an oxygen gas, and the protective layer comprises silicon oxynitride and the stop layer comprises silicon nitride.

Kanegae et al. teaches etching the layer by using oxygen and controlling the electron temperature of the plasma (see paragraph# 161).

It would have been obvious to a person of ordinary skill in the requisite art at the time of the invention was made to optimize the concentration of hydrogen within the dielectric layer,

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since it has been held that where the general conditions of a claim are disclosed in the prior art (i.e.-the electron temperature, and the plasma density, the magnitude of the angles), discovering the optimum or workable ranges involves only routine skill in the art. In re Aller, 105 USPQ 233 (CCPA 1955).

The specification contains no disclosure of either the critical nature of the claimed arrangement (i.e.- the electron temperature, and the plasma density, the magnitude of the angles) or any unexpected results arising therefrom. Where patentability is said to be based upon particular chosen limitations or upon another variable recited in a claim, the applicant must show that the chosen limitations are critical. In re Woodruff, 919 F.2d 1575, 1578 (FED. Cir. 1990).

Therefore, it would have been obvious to a person of ordinary skill in the requisite art at the time of the invention was made would etching the layer by using oxygen and controlling the electron temperature of the plasma in process of Hsieh et al. because the process would provide an dual damascene structure eliminate the occurrence of facet and fencing.

Gabriel et al. teaches forming a dual damascene structure by forming an etch stop layer (12) and protective layer (16, called etch stop layer) by using silicon nitride and oxynitride (see col. 5, lines 60-63).

Therefore, it would have been obvious to a person of ordinary skill in the requisite art at the time of the invention was made would forming the etch stop layer and protective layer in process of Hsieh et al. because it would prevent over etch and to protect the underlying layer.

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Allowable Subject Matter

Claims 5-7, 15-16 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Thanh Nguyen whose telephone number is (571) 272-1695, or by Email via address Thanh.Nguyen@uspto.gov. The examiner can normally be reached on Monday-Thursday from 6:00AM to 3:30PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead, can be reached on (571) 272-1702. The fax phone number for this Group is (571) 273-8300.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Group receptionist whose telephone number is (703) 308-0956 (See **MPEP 203.08**).



Thanh Nguyen
Patent Examiner
Patent Examining Group 2800

TTN